

Pollution Prevention Resources For Healthcare Facilities



Web-Based Listings for Mercury, Dioxin, and Other PBT Reduction Opportunities

Prepared by
New Hampshire Department of Environmental Services
Pollution Prevention Program



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About this Resource

The New Hampshire Department of Environmental Service's (DES) Pollution Prevention Program (NHPPP) prepared this resource as a quick-reference guide to provide New Hampshire hospitals and other healthcare facilities with information and resources regarding persistent, bioaccumulative toxics (PBTs) such as mercury and dioxin. NHPPP recognizes that there are many useful documents on these topics already published, and wishes not to "re-invent the wheel," but to guide the healthcare facilities toward the most useful resources currently available. This guide introduces healthcare facilities to many useful web sites created by technical assistance providers, non-profit organizations and state agencies dedicated to promoting pollution prevention and waste reduction.

Mercury, Dioxin and Other P2 Opportunities

While there are many opportunities for hospitals and other healthcare facilities to use P2, this document's primary focus is on reducing mercury, dioxin and other PBTs in healthcare facilities. This focus was chosen because the state of New Hampshire has mercury reduction and dioxin reduction strategies, and because EPA has included mercury, dioxin, and cadmium on their list of national priorities for waste minimization in 2002.

As mentioned above, this document is designed as a reference document to aid facilities in finding assistance with their waste reduction and pollution prevention activities, particularly decreasing the amount of waste being incinerated. It is worth noting that this document is designed to aid all N.H. healthcare facilities, not just those with onsite incinerators. Most healthcare facilities send their wastes offsite for treatment, but much of this waste is incinerated, and the healthcare facility still bears responsibility for the ultimate treatment and fate of this waste.

Disclaimer

Vendors referenced in this document are not necessarily the only available options, nor does their listing imply endorsement from New Hampshire Department of Environmental Services. They are merely offered as a reference to healthcare facilities in search of alternative pollution prevention products and services.

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I. Pollution Prevention at Healthcare Facilities

Pollution Prevention

Stated simply, pollution prevention (P2) avoids or minimizes generation of waste from the start. P2 means **reducing** or **eliminating** the generation or toxicity of **waste** at its source. P2 avoids the transfer of pollutants or wastes from one medium (such as air, water or land) to another, and includes water and energy conservation.

Pollution prevention can be as simple as improving preventive maintenance and fixing leaks. It might involve upgrading to an energy-saving technology. It may be as easy as purchasing environmental preferable products.

In general the pollution prevention planning process is six simple steps.

1. Get Organized.
2. Analyze Processes.
3. Identify Alternatives.
4. Evaluate Alternatives.
5. Implement Projects.
6. Measure Progress.

Benefits of P2

There are many benefits to pollution prevention. These include, but are not limited to:

- Decreased waste management, handling, and disposal costs.
- Reduced chemical purchases.
- Healthier work place.
- Enhanced community image.
- Decreased liability risks.

Since 1998, NHPPP has been partnered with the U.S. Environmental Protection Agency (EPA) and Foundation for Healthy Communities to undertake a project promoting the reduction of mercury at healthcare facilities. This on-going project involves providing on-site assistance at participating facilities, setting up an infrastructure to promote continuous environmental improvement, and providing outreach and training activities to N.H. healthcare facilities, as well as the creation of this document.

P2 Can Help Healthcare Facilities

Healthcare facilities face substantial challenges keeping costs down, competing in the marketplace, and complying with increasingly stringent and complex regulations, while maintaining a high quality of care. Recently, environmental regulatory agencies have stepped up enforcement efforts aimed at the medical and dental sector. At the same time, growing environmental awareness among local communities has resulted in healthcare facilities paying more attention to these issues.

P2 strategies, like reducing the amount of toxic material going into a facility, are key to minimizing the environmental impact of that facility's operations. Eliminating the use of toxic

substances, such as mercury, can reduce risk to healthcare professionals, patients, and the environment, as well as reducing environmental liabilities. In addition, the healthcare facilities can save significant amounts of money through decreased purchase, management and disposal costs.

An easy way to implement a P2 project for hospitals is provided in the following box. Solvent distillation units can greatly reduce hazardous waste and provide significant savings.

P2 Opportunity for Hospitals: solvent distillation units

Solvent distillation units recycle cleaning or other solvents, such as xylene, and have a very short payback period. There are a variety types and sizes of units available from vendors (a wealth of information is available online). These units can be used to produce 99.9 percent pure, or “white grade” solvent. By recycling and reusing this solvent over and over, a hospital can save significant amounts of money by not having to purchase virgin solvent and by reducing hazardous waste disposal costs previously incurred from the disposal of waste solvent.

Environmentally Preferable Purchasing

Environmentally Preferable Purchasing (EPP) designates techniques, protocols or policies that organizations can use to ensure that the environmental impacts of the products they purchase are screened and minimized before they enter a facility. EPP is a pollution prevention strategy because it eliminates purchasing *hazardous products* that could eventually be a *hazardous waste*. EPP techniques can be used to ensure that environmentally friendly products are purchased, when possible, and to prevent certain toxics (such as mercury-containing items) from entering the facility. EPP can be expanded to consider environmental choices for all purchasing choices.

- Environmentally Preferable Purchasing How-To Guide
Chapter 5 in Health Care Without Harm’s *Going Green*
www.noharm.org/library/docs/Going_Green_5-1_Environmentally_Preferable_Pur.pdf
- Healthcare Environmentally Preferable Purchasing
www.state.ma.us/ota/support/med.htm#epp

P2 Resources and Information

There are many websites with useful P2 opportunities and mercury and dioxin reduction information. The programs with the most information on P2, mercury, dioxin, and a host of other topics can be found at the following websites. Particular documents or web pages on these and other sites throughout this resource are referenced for your convenience.

Hospitals for a Healthy Environment

www.H2E-online.org

Hospitals for a Healthy Environment (H2E) is a joint effort by the American Hospital Association, EPA, Health Care Without Harm and the American Nurses Association. H2E strongly supports eliminating mercury-containing waste from the healthcare waste stream, reducing the volume of generated waste, and minimizing the production of persistent, bioaccumulative and toxic pollutants (PBTs).

Health Care Without Harm

www.noharm.org

Health Care Without Harm's (HCWH) mission is to transform the healthcare industry worldwide, without compromising patient safety or care, so that it is ecologically sustainable and no longer a source of harm to public health and the environment. HCWH will accomplish this by:

- Promoting comprehensive pollution prevention practices.
- Supporting the development and use of environmentally safe materials, technology and products.
- Educating and informing healthcare institutions, providers, workers, consumers, and all affected constituencies about the environmental and public health impacts of the healthcare industry and solutions to its problems.

Their website is focused on various topics including polyvinyl chloride (PVC), incineration, mercury, pesticides and pollution prevention.

The Sustainable Hospitals Project

www.sustainablehospitals.org/cgi-bin/DB_Index.cgi

The Sustainable Hospitals Project provides technical support to the healthcare industry for selecting products and work practices that reduce occupational and environmental hazards, maintain quality patient care, and contain costs. Their website is designed to assist hospitals in procuring more environmentally friendly products.

Foundation for Healthy Communities

www.healthynh.com and click on *Healthy Environment*.

The New Hampshire Hospital Association's Foundation for Healthy Communities (FHC) works to provide information to hospitals in the state to advance their environmental improvement efforts. It does this through its web site, environmental newsletter for hospitals (*STATGreen*), educational programs, and by facilitating regular business meetings of the New Hampshire Hospitals for a Healthy Environment network.

New Hampshire Hospitals for a Healthy Environment

www.healthynh.com and click on *Healthy Environment*.

In direct response to the ongoing interest expressed by New Hampshire's hospitals regarding issues such as mercury reduction, recycling, waste minimization, environmentally preferable purchasing, and other information geared towards environmental improvement, the Foundation for Healthy Communities announced the formation of the New Hampshire Hospitals for a Healthy Environment (NH3E) network in July 2001. NH3E is a network of New Hampshire hospitals concerned with how their practices can impact the environment and health of the communities they serve. Its purpose is to learn and share information on vendors, environmental rules, and

training opportunities with other New Hampshire hospitals facing similar concerns and challenges while working to reduce both the volume and toxicity of their waste.

Pollution Prevention Resource Exchange

www.P2rx.org

Pollution Prevention Resource Exchange (P2Rx) was created in 1997 by EPA to lay the groundwork for a seamless national network of P2 information that promotes waste reduction throughout the U.S. In the past, finding information required valuable time and resources. P2Rx is for business, government, citizens, and technical assistance providers to access P2 information.

P2Rx is composed of eight regional centers that offer a range of services, including information for industry and topic sectors, training, library resources, referrals and research. Through P2Rx, the centers collect, synthesize, and update technical information; and provide contact information for experts and other sources. Visit the P2Rx *Medical Care* hub website located at:

www.p2rx.org/P2InfoNexpert/medical.cfm.

Additional Resources to Review

- Eleven Recommendations for Improving Medical Waste Management
www.nihe.org/elevreng.html
- Environmental Self-Assessment For Healthcare Facilities
www.getf.org/file/toolmanager/O16F4755.pdf
- Guides for Pollution Prevention -- Selected Hospital Waste Streams
www.p2pays.org/ref/02/01059.pdf
- Health Care Pollution Prevention
www.state.ma.us/ota/support/med.htm
- Publications and Articles on Pollution Prevention
www.nihe.org/publicat.html

II. Mercury

Mercury is highly toxic to humans and wildlife. It accumulates in the tissues of fish and other organisms inhabiting mercury-contaminated waters and builds up in the tissues of organisms higher up the food chain, including fish and subsequently, humans. Contamination of New Hampshire's lakes with mercury has resulted in fresh water fish advisories and in some cases, a complete ban on any consumption of fish, throughout the state. This contamination comes from airborne mercury, and is a problem all across the United States.

In humans, mercury is toxic to the nervous system, affecting the brain and spinal cord, and is also toxic to the kidneys and liver. Mercury exposure is particularly significant for young children and pregnant women because mercury easily crosses the placenta where it inhibits the development of the brain and the nervous system of the developing fetus. Lowered intelligence, impaired hearing, and poor coordination are some of the effects seen in children with elevated mercury exposure.

Approximately 98 percent of the mercury released into the air in New Hampshire comes from the combustion of fossil fuels, such as coal and oil, and the incineration of waste (municipal solid waste and medical waste). Mercury may also become airborne when mercury-containing products are improperly disposed of or accidentally broken. DES estimated in its 1998 *Mercury Reduction Strategy* (see below), that hospitals facilities with incinerators contributed approximately 9 percent of all airborne mercury in New Hampshire. The estimate was based primarily on 1997 data.

New Hampshire's Mercury Reduction Strategy

Adopted in October 1998, DES's *Mercury Reduction Strategy for New Hampshire* (www.des.state.nh.us/nhppp/merc20.htm) contains 40 recommendations for reducing man-made releases of mercury into the environment, including healthcare. Many of these recommendations involve P2 and focus on preventing mercury pollution, rather than trying to clean up mercury contamination after it becomes a problem.

Reducing Mercury Use and Liability

Healthcare facilities should eliminate or reduce their use of mercury wherever possible. This will reduce the amount of mercury going into the trash and/or being incinerated, and will reduce the amount of mercury waste that needs to be properly disposed. The best way to reduce mercury at any facility is to:

1. Take a facility-wide **inventory** and recycle/dispose any old mercury or mercury-containing items stored onsite.
2. Use **source reduction** techniques to eliminate mercury where possible.
3. Properly **manage the mercury** you cannot eliminate.

1) Inventory

Mercury-Containing Products at Healthcare Facilities

The first step to eliminating mercury at a healthcare facility is to identify where it is being used or stored. Conduct a survey or create an inventory of mercury-containing products throughout the facility. Broken mercury-containing items are often stored in the back of closets or in basement areas because employees are not sure how to properly dispose of them. Mercury can be found in

many items including: fluorescent bulbs, thermostats, tilt switches, relays, thermometers, gastrointestinal tubes, sphygmomanometers (blood pressure cuffs), vacuum gauges, manometers, and button batteries. Mercury is also used in laboratories as a reagent and catalyst for such tests as Chemical Oxygen Demand (COD), and in staining, fixative, and preservative applications.

- EPA: Mercury in the Environment – The Waste Connection
www.epa.gov/grtlakes/p2/mercpam.html
- H2E Self-Assessment Guide
www.h2e-online.org/pubs/selfasmt.pdf
- Instruments, Products, and Laboratory Chemicals Used in Hospitals That May Contain Mercury - Chapter 2-3 in Health Care Without Harm's *Going Green*
www.noharm.org/library/docs/Going_Green_List_of_Mercury-Containing_Items_i.pdf
- Medical Facility Mercury Survey
www.uml.edu/centers/LCSP/hospitals/HTMLSrc/IP_Merc_Tools_Medfacility.html
- Mercury Containing Equipment in Medical Institutions
www.glrppr.org/hubs/subsection.cfm?hub=502&subsec=2&nav=2

Mercury Cleanout

Once you have identified the old or broken mercury-containing items that are stored at the facility (as well as other items that are universal or hazardous waste), you need to have them properly recycled or disposed of as hazardous waste. For a list of mercury recyclers that service N.H., see www.des.state.nh.us/nhppp/vendors.htm.

2) Source Reduction

The best way to keep mercury-containing products out of the waste stream is to purchase and use products that do not contain mercury. It is imperative to work with the facility's procurement staff so that once the mercury-containing items have been removed from the healthcare facility; they do not come back in through the loading dock! Talk to the purchasing director to see what mercury-free products are currently available, then talk to the group purchasing organization (GPO) and suppliers to request additional alternatives.

Fortunately, the use of mercury in medical and laboratory equipment and procedures is diminishing with the advent of non-mercury technologies (such as digital thermometers) and changes in laboratory practices, including conversion to micro-scale procedures. These source reduction techniques promise significant mercury reductions in New Hampshire as several healthcare facilities in the state have implemented a program for, or expressed interest in, going "mercury free."

- Eliminating Mercury Use in Hospital Laboratories: A Step Toward Zero Discharge
www.noharm.org/library/docs/Eliminating_Mercury_Use_in_Hospital_Laboratori.doc

- How To Establish Mercury Pollution Prevention In Your Hospital
www.uml.edu/centers/LCSP/hospitals/HTMLSrc/IP_Merc_How.html
- National Microscale Chemistry Center
www.silvertech.com/microscale/index.html
- Protecting By Degrees: What Hospitals Can Do To Reduce Mercury Pollution
www.noharm.org/library/docs/Protecting_by_Degrees_2.pdf
- Waste Reduction Activities For Hospitals
www.ciwmb.ca.gov/bizwaste/factsheets/hospital.htm

Reducing Mercury Emissions by Reducing Red Bag Waste at N.H. Healthcare Facilities

The Red Bag Issue

When healthcare facilities investigate what is being discarded in their red bags, they almost always find a lot of items that could be disposed of in the trash as solid waste. NHPPP does not advocate slipping infectious waste into the trash, but red bags are often full of coffee cups and various types of non-infectious medical waste. Educating staff on the expense and environmental consequences of red bag waste disposal is the first step in reducing the amount of red bag waste generated at your facility. Successful red bag reduction programs have shown that the amount of red bag waste and associated disposal costs can be cut significantly. One example is Elliot Hospital's red bag waste reduction program.

Red Bag Reduction: Significant Savings at Elliott Hospital

Prior to starting the reduction program, 50 percent of their clinical and lab waste ended up in red bags. After the program was implemented, only 10-15 percent of the waste was red bagged, for a six figure annual cost savings.

A host of literature and case studies exists on reducing red bag waste and costs, some of which can be found at:

- 10 Ways to Reduce Regulated Medical Waste
Health Care Without Harm's Going Green Chapter 4-2
www.noharm.org/library/docs/going_green_4-2_10_Ways_to_Reduce_Regulated_Me.pdf
- Products and Resources for Category: Infectious Waste (Red) Bags
www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Cat&id=24

- Waste Reduction Guide: Cutting Costs & Minimizing Waste From Your Facility – Section 7: More About Regulated Medical Waste
www.h2e-online.org/pubs/section7.pdf

Another Reason to Reduce Red Bag Waste: Cadmium

Reducing your red bag waste will not only reduce mercury emissions, but also reduce cadmium emissions if your bags are incinerated (on- or off-site). The red dye in “red bags” sometimes contain cadmium; therefore when incinerated, cadmium emissions can cause air quality and health issues. Long-term exposure to low levels of cadmium can cause kidney disease, lung damage and fragile bones. A better option is to use cadmium-free red bags.

Information on red bags that **do not** contain cadmium can be found at Sustainable Hospitals website at: www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Haz&id=9.

Mercury-free Alternative Products Are Available For Healthcare Facilities

Healthcare facilities can reduce their use of mercury by replacing mercury-containing instruments (like thermometers and sphygmomanometers) with non-toxic alternatives. Many healthcare facilities have done this already, in response to the exorbitant cost of mercury spills, or to reduce their liability. High quality, workable alternatives already exist for most mercury-containing products and many hospital suppliers/vendors carry these alternatives.

- Mercury Reduction (alternative product listings)
www.uml.edu/centers/LCSP/hospitals/HTMLSrc/IP_Mercury.html
- Four ways to find alternative products
www.sustainablehospitals.org/cgi-bin/DB_Index.cgi.

Incineration of Infectious Waste

Recent hospital/medical/infectious waste incinerator (HMIWI) closings have eliminated the majority of mercury emissions coming directly from healthcare facilities in the state. As of April 2002, there have been only two operating HMIWI's in New Hampshire; however, much of the infectious waste generated at the other NH healthcare facilities is still incinerated off-site/out-of-state. In general, more waste is treated by incineration than is required by law. HCWH recommends that the incineration of healthcare facilities' wastes should be limited to the relatively small portion of regulated medical/infectious waste for which incineration is legally and medically required as the only treatment method. DES strongly supports this recommendation. Please see **Section IV: Issue with Incineration** for a more detailed discussion of incineration and alternative technologies.

3) Proper Mercury Management

Even with the best of efforts, it may not be possible to get rid of absolutely all the mercury in a facility. If using products that contain mercury, **all** appropriate facility personnel must be trained to ensure that these items are recycled or disposed of properly, so they do not end up in red bags, where they could be incinerated or autoclaved. Often only “key” personnel are trained, and the information does not make it down to all of the staff that uses red bags for waste disposal.

In addition, ensure that the facility has mercury spill cleanup kits on hand located near where mercury products are used and that staff are trained on how to properly clean up mercury spills. Emergency contact information in case of a spill should also be posted nearby.

The following sites contain information on how to clean-up mercury spills. If you do have a mercury spill, it needs to be reported to the state. Immediately call DES's Special Investigation Unit at 603-271-3899, from 8-4:00 Monday through Friday, or after hours, contact the State Police at 1-800-346-4009.

- Mercury Reduction: Spills
www.uml.edu/centers/LCSP/hospitals/HTMLSrc/IP_Merc_BMP_Spills.html
- Cleaning Up Small Mercury Spills
www.michigan.gov/deq/1,1607,7-135-3585_4127_4175-11751--,00.html

Hazardous and Universal Waste Rules

Most healthcare facilities generate some amount of hazardous waste and are consequently subject to New Hampshire's Hazardous Waste Rules, which can be found at www.des.state.nh.us/hwrb/hwrules.pdf. Each facility must properly manage its mercury-containing and other hazardous wastes. Most healthcare facilities are well aware of these requirements. However, a clarification of universal waste is presented below.

Spent mercury-containing products may be managed as **universal waste** if they are recycled, or as **hazardous waste** if they are disposed. Hazardous wastes are managed under the Resource Conservation and Recovery Act (RCRA) and the *N.H. Hazardous Waste Rules*. Universal wastes are wastes that meet the definition of hazardous waste in the *N.H. Hazardous Waste Rules*, but during accumulation and transport, pose a relatively low risk compared to other hazardous wastes. Wastes that DES has determined meet universal waste criteria include mercury-containing lamps and devices, used antifreeze, certain types of batteries, cathode ray tubes, and recalled or suspended hazardous waste pesticides regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Generally, it is easier and cheaper to manage a waste as a universal waste. Regulations governing universal waste are less stringent than those governing hazardous waste. That said, universal wastes must be stored properly to prevent release, labeled correctly, and self-transported or shipped with a Bill of Lading offsite. For information on universal wastes, see DES's fact sheets at:

- Mercury Containing (Universal Wastes) Devices: Management Requirements for Handlers and Transporters
www.des.state.nh.us/factsheets/hw/hw-17.htm
- Best Management Practices for Mercury-Containing Products in the Hospital
www.uml.edu/centers/LCSP/hospitals/HTMLSrc/IP_Merc_BMP.html

A Word on Fluorescent Lamps

Fluorescent lamps should not be placed in the trash, and must be handled as either a hazardous waste or as universal waste. **All fluorescent lamps contain mercury and should be recycled.** Some lamps are sold as “non-hazardous” (commonly referred to as “green-tip” lamps) and can legally go in the trash if they pass hazardous waste testing, known as Toxicity Characteristic Leaching Procedure, or TCLP; however DES highly discourages this practice, because these lamps still contain about 10 mg of mercury each. Additionally, it has been anecdotally reported that these lamps burn out more quickly than regular fluorescent lamps, thus releasing just as much mercury into the environment (per area or per ballast) as regular fluorescent lamps. Please note that lamp crushers must obtain a permit or go through the waiver process with DES’s Hazardous Waste Compliance Section.

Non-profit healthcare facilities are eligible to use the State of New Hampshire’s fluorescent lamp contract. To receive a copy of the contract or the current rate of fluorescent lamp recycling or to purchase a reduced rate spill kit, contact NHPPP at 603-271-2956.

- Universal Waste Lamps: Management Requirements for Handlers and Transporters
www.des.state.nh.us/factsheets/hw/hw-7.htm
- Fluorescent Lamp and Ballast Recycling Facilities
www.des.state.nh.us/pcas/lamplist.htm

Basically, it’s a lot easier and cheaper to reduce your mercury through source reduction than it is to worry about its proper handling and disposal.

III. Dioxin and Polyvinyl Chloride

The term "dioxin" refers to a group of chemical compounds that share certain similar chemical characteristics and common mechanisms of toxicity. Dioxin is created as an unintended by-product of a reaction of chlorine and organic molecules in a process such as incomplete combustion or as a contaminant in chemical manufacturing processes. Although dioxin is released into the environment in small quantities, it builds up in soil, sediment and plants, bioaccumulates in animal and fish tissue, and is passed up the food chain to people. Dioxin also bioaccumulates in a woman's body and is passed to her infant through breast milk.

Dioxins modulate and disrupt growth factors, hormones, enzymes and developmental processes. Additionally, both animal and human epidemiological studies conclude that dioxin is toxic to the developing immune system and is a known human carcinogen.

- Dioxin, PVC and Health Care Institutions
Section 3-1 of *Going Green*
www.noharm.org/library/docs/Going_Green_3-1_Dioxin_PVC_and_Health_Care.pdf
- How To Start To Stop Dioxin Exposure In Your Community
www.noharm.org/library/docs/Stop_Dioxin_Exposure.htm

New Hampshire's Dioxin Reduction Strategy

As part of its continuing efforts to address persistent bioaccumulative toxics (PBTs), DES began an initiative to substantially reduce dioxin contamination in New Hampshire's environment. In March 2001, New Hampshire adopted the first-in-the-nation strategy developed by DES to substantially reduce harmful dioxin emissions in the state. *The New Hampshire Dioxin Reduction Strategy* (February 2001) recommends actions that are expected to cut dioxin emissions from a variety of sources in half by 2003.

Some of the recommended actions for hospitals still operating medical waste incinerators (or those facilities that incinerate their waste) include the virtual elimination of all PVC-containing products from the medical waste stream by 2005. The strategy also calls for phasing out the operation of all medical waste incinerators in the state by 2010. Other recommended actions include the promotion of environmentally safer methods of medical waste management, such as reducing the use of chlorine-containing products that emit dioxins when incinerated and using alternative disposal methods such as sterilization. The *Strategy* also calls for legislation to be drafted that would prohibit the disposal of PVC-containing products in medical waste incinerators. To see a full copy of the *Strategy*, visit www.des.state.nh.us/ard/dioxin/strategy.pdf.

At the time the *Dioxin Strategy* was published, DES estimated that HMIWIs operating in New Hampshire produced almost 29 percent of the state's total dioxin emissions. This is higher than the national average, estimated in 1995, when HMIWIs were estimated to produce 11.5 percent of the nation's total dioxin emissions. Since April 2001, the percentage of dioxin emissions in New Hampshire generated by hospital incinerators has decreased because a number of incinerators have closed. It must be kept in mind, however, that most infectious waste generated by healthcare facilities is shipped out of state where it is still incinerated.

PVC Use

PVC plastic is a major source of chlorine in the medical waste stream and can lead directly to increased dioxin emissions from incinerators. PVC plastics can contain up to 57 percent chlorine by weight. Since PVC is more than 50 percent chlorine by weight, it is a major precursor (chlorine "donor") in the formation of dioxin.

PVC-containing items commonly used in healthcare include medical equipment such as IV bags, tubing, endotracheal tubes, oxygen tents, mattress covers, packaging and office supplies such as binders. PVC is also used in healthcare facility building materials, including wiring, flooring, wall coverings, pipes, etc. It is a very brittle, unstable polymer, so depending upon its intended use, many plasticizers (for flexibility and softness), stabilizers and other additives may be present. These additives do not actually bond with the PVC polymer and are subject to leaching, or breaking free, from the PVC and into the surrounding environment. Two concerns have been raised about the safety of PVC:

1) Incineration of disposed PVC products can result in the formation of dioxin.

A large body of evidence has shown a link between the amount of chlorine entering an incinerator and the dioxin emissions that leave the smokestack. PVC products contribute as much as 80 percent or more of the total chlorine fed into medical waste incinerators. The dioxin formed by these incinerators is emitted as stack gases or is contained in ash residues. For more information on alternative technologies and products, reducing your use of PVC-containing products, and medical reports and studies on DEHP, see:

- Dioxin and Related Compounds
cfpub.epa.gov/ncea/cfm/dioxin.cfm?ActType=default
- PVC
www.noharm.org/index.cfm?page_ID=6
- PVC
www.sustainablehospitals.org/HTMLSrc/IP_PVC.html

2) DEHP, Di (2-ethylhexyl) phthalate, a plasticizer used in PVC products for flexibility and softness, can leach out of PVC into contained liquids such as IV fluids and internal feeding products. DEHP has been identified as a developmental and reproductive toxin.

The EPA has identified both dioxin as a known carcinogen and DEHP as probable carcinogens and possible endocrine disrupters. Studies conducted by the governments in the U.S., Canada and the European Union all conclude that exposure to DEHP is a concern. Populations most at risk include critically ill infants, healthy infants and toddlers, and pregnant and lactating women. The reports generally recommend action to reduce DEHP exposure in healthcare, particularly for the more vulnerable populations. For more information or to review these studies, see:

- Neonatal Exposure to DEHP and Opportunities for Prevention
www.noharm.org/library/docs/Neonatal_exposure_to_DEHP_and_opportunities_for.pdf

- Weight of Evidence: DEHP Exposures are a Cause for Concern, Especially During Medical Care
www.noharm.org/library/docs/Going_Green_3-11_The_Weight_of_Evidence_on_DEH.pdf

Reducing Polyvinyl Chloride Use

Healthcare facilities should eliminate or reduce their use of polyvinyl chloride (PVC) products wherever possible. This will reduce the amount of dioxin being incinerated. The best way to reduce PVC product use at any facility is to:

1. Take a facility-wide **inventory** of all PVC products onsite.
2. Use **source reduction** techniques to eliminate the use of PVC products where possible.
3. Properly **manage the PVC products** you cannot eliminate.

1) Inventory

PVC Products at Healthcare Facilities

PVC-containing products are commonly used in medical equipment, packaging and in hospital building materials. Products containing PVC in the hospital may include:

Basins	Medical Gloves
Bedpans	Office Supplies
Blood Bags	Packaging
Catheters	Patient ID Bracelets
Drip Chambers	Respiratory Therapy Products
Internal Feeding Devices	Stationary Supplies
Hemodialysis Equipment	Tubing
IV Containers	Thermal Blankets
Lab Equipment	Anything that contains vinyl

For more information on PVC inventory: www.sustainablehospitals.org.

2) Source Reduction

Healthcare Facilities Can Reduce the Use of PVC Products

Source reduction includes eliminating the purchase and use of chlorine-containing materials that create dioxin. As with mercury reduction, the best way to keep PVC-containing products out of the waste stream is to purchase and use products that do not contain PVC. Again, it is imperative to work with the facility's procurement group and GPO so that once the PVC products are removed from the healthcare facility, they do not come back in through the loading dock! Please refer to the paragraph on **environmentally preferable purchasing** under Source Reduction in the Mercury section of this document.

Source Reduction Techniques

Waste separation is crucial to reducing the volume and toxicity of the medical/infectious waste stream and preventing the generation of dioxin. Many materials disposed at hospitals and other medical facilities can be handled as ordinary solid waste and need not be disposed of as "red bag" or infectious waste, which will more likely be incinerated. Examples of PVC-containing items that are often red bagged, but may be solid waste, include saline IV bags and tubing, gloves, and

packaging. There is the added problem that a large volume of solid waste in N.H. is incinerated, but that problem is outside the scope of this document.

Alternative Products Are Available For Healthcare Facilities

Reducing the amount of PVC-containing material brought into a healthcare facility is by far the most effective and inexpensive way to reduce dioxin emissions. Healthcare facilities have begun to replace some of their PVC-based products and packaging with non-toxic alternatives like **non-chlorinated plastics or equipment that can be sterilized** and reused. Many vendors have available, or are developing, PVC-free product lines. Soft plastic tubing, bags, and containers made of chlorine-free polyethylene and polyolefin are readily available. Rigid PVC product alternatives are made of metal and non-chlorinated polypropylene or polycarbonate plastics. Ongoing research into these non-toxic alternatives will make it easier for healthcare facilities to move away from PVC containing products and packaging. If more healthcare facilities demand PVC alternatives, healthcare supply companies will respond. There are many PVC-free substitutes readily available.

The first step is to talk to the healthcare facility purchasing director to determine which PVC-free products are currently available, then talk with the GPO and suppliers to request additional alternatives. Some GPOs have taken steps towards offering alternative products. A good time to request new products is during contract negotiations.

- Alternatives to PVC and DEHP Medical Devices
www.noharm.org/library/docs/Going_Green_3-5_PVC_Alternatives.pdf
- Alternatives to PVC Medical Products
www.noharm.org/library/docs/Alternatives_to_PVC_Medical_Devices.htm
- List of PVC Alternative Products
www.uml.edu/centers/LCSP/hospitals/HTMLSrc/IP_PVC.html
- Non-PVC Purchasing: A Handbook on Non-PVC Products
cold.aaa.dk/pvc/english/index.htm
- Products for Hazard: PVC
www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Haz&id=3

3) Proper Management

The best way to manage PVC-containing products that cannot be eliminated from the facility is to choose disposal options that do not involve incineration (provided the waste does not have to be legally incinerated). See Section IV for information on incineration and alternatives.

IV. The Issue with Incineration

Incineration of medical waste (whether on- or off-site) can emit mercury, dioxin, and other toxic air pollutants. Incineration is also expensive. Incineration should be limited to the relatively small portion of regulated medical/infectious waste for which incineration is the only legally or medically required treatment. Options to reduce the amount of waste being incinerated are source reduction, source separation, and alternative disposal techniques. Specifically, these include:

- Segregating mercury-containing waste from medical/infectious waste.
- Segregating ordinary plastic waste and recyclable materials from medical/infectious waste.
- Reducing the amount of red bag waste.
- Using reusable products when possible.

These options effectively minimize the formation of mercury and dioxin emissions and other pollutants by eliminating the combustion of precursor materials. To reduce the amount of mercury and dioxin emissions, see source reduction techniques, such as using alternative products, discussed in earlier chapters of this document.

The main purpose of incineration or alternative treatment technologies is to decontaminate waste by destroying pathogens. Healthcare facilities and providers have several options for disposal of regulated medical/infectious waste beyond incineration (see below). To review DES's solid waste rules for infectious waste (New Hampshire Code of Administrative Rules, Env-Wm 2604) see: www.des.state.nh.us/rules/swrules.pdf.

Alternative Medical Waste Treatment Strategies

Alternative treatment technologies must meet the treatment standards for infectious waste set forth in Env-Wm 2604. Examples include autoclaving, chemical treatment, plasma arc, microwave, low frequency radio wave and gamma irradiation, as well as combinations of these technologies. More and more hospitals and other medical waste generators have selected alternative technologies after evaluating and comparing capital costs, worker safety, ease and cost of operation and maintenance, confidence in the technology, and consideration of the public health benefits associated with the elimination of medical waste incineration.

An Alternatives to Incineration -- a New Hampshire case study

Dartmouth Hitchcock Medical Center in Lebanon went through the process of examining its criteria and priorities for replacing its incinerator, and in 1996 chose to install and operate autoclave units as an alternative treatment technology. These units have proven to be a reliable and cost-effective waste treatment method for handling their medical and infectious wastes.

The four basic alternative practices currently in use are thermal processes, chemical processes, irradiative processes, biological processes, and mechanical processes. The majority of non-incineration technologies employ thermal or chemical processes. Mechanical processes (such as shredding, grinding, mixing, agitation) may be used to supplement these treatment processes.

Each of these processes and a list of technology vendors are presented in detail in HCWH's *Non-Incineration Medical Waste Treatment Technologies* found at:

www.noharm.org/library/docs/Non-Incineration_Medical_Waste_Treatment_Techn.pdf

For an executive summary of this document, go to:

www.noharm.org/library/docs/Non-Incineration_Medical_Waste_Treatment_Techn.pdf

Determining the best technology or combination thereof depends on many site-specific factors as well as cost. Key factors to consider when selecting non-incineration technologies are presented in HCWH's document, and include:

Throughput capacity	OSHA considerations
Types of waste to be treated	Noise and odor
Microbial inactivation efficacy	Degree of automation
Air emissions and waste residues	Reliability
Regulatory acceptance	Level of commercialization
Space/footprint for equipment	Degree to which technology is proven
Utility requirements	Vendor background
Waste volume and mass reduction	Community and staff acceptance

Not one technology offers a magic bullet to all the problems of medical waste disposal; each technology has its own advantages and disadvantages. Each healthcare facility must work with its staff and/or waste treatment facilities to determine which non-incineration technology best meets its needs, while minimizing the impact on the environment, enhancing occupational safety, and demonstrating a commitment to public health. HCWH's document provides general information to assist healthcare facilities to achieving these goals.

V. Other P2 Opportunities

Healthcare facilities generate a number of hazardous chemical wastes. Hazardous chemical waste is not the same as regulated medical waste and should be managed accordingly. Consider reducing other toxic substances at the facility.

- Chemical Minimization Plan
www.h2e-online.org/tools/chemplan.htm

Ethylene Oxide (EtO)

Ethylene Oxide or a mixture of EtO and chlorofluorocarbon (CFC) is used to sterilize medical devices. EtO is a probable human carcinogen, as well as being flammable and explosive. Additionally, CFC is an ozone-depleting chemical.

Relatively small amounts of EtO are used as a fumigant or in healthcare sterilization of surgical equipment and plastic devices that cannot be sterilized by steam.

- Massachusetts Toxics Use Reduction Institute Fact Sheet on EtO
www.turi.org/community/PDF/eo.pdf
- Replacing Ethylene Oxide and Glutaraldehyde
www.ciwmb.ca.gov/wpie/HealthCare/EPAEtOglut.pdf

Formaldehyde/Formalin

Formaldehyde is a compound used in hospital laboratories as a tissue preservative. When present in the air at even very low levels (above 0.1 parts per million), it can cause a number of symptoms, including watery eyes, burning sensations in the eyes, nose and throat, nausea, coughing, chest tightness, wheezing, skin rashes, and other allergic reactions.

Hospital personnel are at risk, as eye contact can lead to severe burns that may not respond to eye washing. Some people develop allergic reactions through skin contact with formaldehyde solutions. Prolonged skin contact causes dermatitis and sensitization of the skin and the respiratory tract.

- Chemical Purchasing Practices
www.c2p2online.com/documents/biomedicalP2information.pdf
- Formaldehyde-Free Products
www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Haz&id=5

Glutaraldehyde

Glutaraldehyde has been used as a healthcare equipment disinfectant for over forty years. Initially, it was considered an effective alternative to the highly toxic, irritating, and carcinogenic disinfectant formaldehyde. However, occupational health problems associated with glutaraldehyde include skin irritation, asthma or possibly chemical sensitivity. Today, there are

alternatives that offer a high level of disinfection while protecting health care workers and the environment. That said, there are also questions being raised about the safety of some of the alternatives. As with most chemicals, the best option is to use less and use it safely.

- “10 Reasons to Eliminate Glutaraldehyde” fact sheet
Glutaraldehyde Control in Hospitals
Glutaraldehyde Use Survey
www.sustainablehospitals.org/HTMLSrc/IP_Glutfactsheets.html
- Alternatives to Glutaraldehyde
www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Haz&id=8

Xylene

Xylene is used in histology and cytology laboratories in anatomic pathology departments. Xylene is a central nervous system depressant and may also cause lung damage. High vapor concentrations may cause headache, nausea, dizziness, drowsiness, and confusion. Xylene can cause skin irritation and is also a possible reproductive hazard - it may cause fetotoxicity, based on animal information.

- Waste Reduction and Disposal Options for Specific Hospital Wastes
www.p2pays.org/ref/01/00239.pdf
- Xylene-Free Products
www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Haz&id=6

VI. Promotional Opportunities

Hospitals for a Healthy Environment (H2E)

www.h2e-online.org/programs/award/awards.htm

Hospitals for a Healthy Environment (H2E) is a joint effort by the American Hospital Association, EPA, Health Care Without Harm and the American Nurses Association. H2E strongly supports eliminating mercury-containing waste from the healthcare waste stream, reducing the volume of generated waste, and minimizing the production of persistent, bioaccumulative and toxic pollutants (PBTs). Hospitals agree (partner) to pursue H2E program goals:

1. Virtually eliminating mercury-containing waste from their hospital's waste stream by 2005.
2. Reducing the overall volume of waste (both regulated and non-regulated) by 33 percent by 2005 and by 50 percent by 2010.
3. Identifying hazardous substances for P2 and waste reduction opportunities, including hazardous chemicals and PBTs (persistent bioaccumulative and toxic pollutants).

Listed below are the New Hampshire hospitals that are partners in H2E:

Alice Peck Day Memorial Hospital, Lebanon
Concord Hospital, Concord
Dartmouth-Hitchcock Medical Center, Lebanon
Elliot Hospital, Manchester
Franklin Regional Hospital, Franklin
Huggins Hospital, Wolfeboro
Littleton Regional Hospital, Littleton
Mondanock Community Hospital, Peterborough
New London Hospital, New London
Parkland Medical Center, Derry
St. Joseph Hospital, Nashua
Southern New Hampshire Medical Center, Nashua
Upper Connecticut Valley Hospital, Colebrook
Veteran's Affairs Medical Center, Manchester
Wentworth Douglass Hospital, Dover

H2E also presents a number of environmental awards to partners and champions for a variety of accomplishments, from doing pollution prevention projects, to demonstrating that their facility is setting the industry standard for environmental programs and practices.

New Hampshire Governor's Award for Pollution Prevention

Another promotional opportunity is the New Hampshire Governor's Award for Pollution Prevention. Two hospitals won the Governor's Awards in 1999: Dartmouth Hitchcock Medical Center and Concord Hospital. Below is a case study of the Concord Hospital project. For more information on the Governor's Award for Pollution Prevention, visit www.des.state.nh.us/nhppp/nh01003.htm.

Concord Hospital was recognized with a 1999 Governor's Award for its "Mercury Reduction Plan." The plan was developed due to Concord Hospital's concerns about mercury and its effect on the long-term health of employees and the community.

Within the hospital, four areas were targeted for mercury reduction: operating rooms, ambulatory care center, laboratory, and maternity unit. In 1998, Concord Hospital reduced mercury by recycling 34 pounds of mercury-filled esophageal dilators, 7,578 feet of fluorescent tubes, 160 fluorescent "U-tubes," and four pounds of broken mercury-containing thermometers and manometers. In January of 1999, the maternity ward began placing digital thermometers in its newborn care kits, effectively removing more than 1,200 mercury thermometers from the region's waste stream annually.

VII. Other Useful Websites and Links

- Physicians for Social Responsibility: www.psr.org
- Nightingale Institute for Health and the Environment: www.nihe.org
- Center for Environmental Health: www.cehca.org/shear
- P2 Gems: www.p2gems.org
- Hospitals and Pollution Prevention: www.epa.state.nh.us/opp/hospital.html
- New Hampshire Hospital Association: www.nhha.org

VIII. Conclusion: Pollution Prevention for Healthcare Facilities

Healthcare facilities in New Hampshire and across the country are already using pollution prevention techniques to reduce the toxicity, volume and disposal costs of their wastes, reduce their mercury and dioxin emissions, and lower their liability. We hope that using this guide will further healthcare facility's efforts to prevent pollution. For more information please contact Sara Johnson of NHDES at 1-800-273-9469 or sjohnson@des.state.nh.us or Debbie Augustine of the Foundation for Healthy Communities at 603-225-0900 or daugustine@nhha.org.